HP-IL Introduction

On December 21, 1981, the Hewlett-Packard Interface Loop concept became a reality. This date marked the beginning of a new era in low-cost systems for electronic data transfer and electronic control.

Now, your HP-41 hand-held computer can easily communicate with, and control, any Hewlett-Packard Interface Loop (HP-IL) peripheral. Present HP-IL peripherals include a printer, a digital cassette drive, a converter, and a digital multimeter.* But that's not all. A video interface is jumping ahead; let's discuss the fundamentals.

The HP-IL concept revolves around a two-wire cable that can connect as many as 30 HP-IL devices in a closed loop. HP-IL is a “master-slave” interface, meaning that one active controller regulates the information flow between all of the devices in the loop. Data and commands move around the loop in one direction.

The reason we use such terms as “the controller” and “a device” is because HP-IL is a general-purpose interface. The elements of the system that you choose to use will be tailored specifically to your application. This is the flexibility of the HP-IL concept.

At the core of this new concept is the new HP 82160A HP-IL Module. This module fits into any of the four HP-41 ports, and it expands the HP-41 with a powerful set of functions for interaction with the devices in the loop. Now, printers, mass-storage devices, and a variety of instruments can be controlled by the HP-41 through one port!

THE CASSETTE DRIVE

The new HP 82161A Digital Cassette Drive is an HP-IL mass-storage device. Each of the digital mini-cassettes driven by this device can store up to 131,072 bytes of data, programs, status information, and directory in files that you name. Just think: 131,000 bytes is over 50 times the full RAM capacity of the HP-41CV! In fact, we have stored on just ¼ of one mini-cassette, all of the programs in every HP-41 “Solutions” book! This is why we call it mass storage. Also, the HP 82161A Digital Cassette Drive is fast, with an average file access time of 15 seconds, and a 30-second maximum rewind time. Yet, accessing a program file is easy. With the Digital Cassette Drive in the loop, simply place the name of the file in the ALPHA register, key in \texttt{XEQ “READP"}, and the program is available in the RAM of your HP-41 within seconds. Other files are accessed (and recorded) just as easily by executing different HP-IL commands.

THE PRINTER

The new HP 82162A Thermal Printer/Plotter is an HP-IL compatible device that is similar in appearance and function to the HP 82143A Thermal Printer/Plotter. In addition to all of the convenient features of the HP 82143A Thermal Printer/Plotter such as double- and single-wide printing, right and left justifying, 128 standard characters, and special character building, the new HP-IL printer has a FORMAT statement that allows you to automatically center words on the page and to easily right- and left-justify two columns. Plus, the new HP 82162A Thermal Printer/Plotter has a 101-element buffer, and a STANDBY position of the on-off switch helps conserve battery power.

(Continued)
THE MULTIMETER AND THE CONVERTER

With HP-IL, your HP-41 can control, and take data readings from, the new HP 3468A Digital Multimeter. Or, if you have a considerable knowledge of electronics and interfacing techniques, you can use the new HP 82166A HP-IL Converter to connect your own 8 or 16 bit-parallel device into the HP-IL system.

A general application of such an HP-IL system would use the new HP 82182 Time Module, which is discussed in the following article, to “wake-up” the HP-41 in the middle of the night, while you are at home sleeping. Automatically, then, the HP-41 would begin to execute a control program.

HP-IL allows you to program the HP-41 to power-up devices in the loop, take readings from instruments, make data listings, read subprograms from mass storage devices, and interact with other devices in the loop as prescribed by the programs. The extensive programming capabilities of the HP-41 allow it to make critical decisions based on the data received from the instruments in the loop and interact with other devices in the loop, accordingly. Then, with its job complete, the HP-41 can power-down the devices in the loop, including itself. When you arrive at work in the morning, after a good night’s rest, a printer listing awaits you, documenting the events of the night as monitored by the HP-41!

SEE YOUR HP DEALER...

At this point, you have read the introduction to an entirely new concept in electronic communication and control that represents a major technological breakthrough. This is a good point to sit back, relax, and think about the implications of the HP-IL concept. Just think: now, with the HP products that were announced on December 1, 1981, thousands of electronic control applications can be tackled by portable, affordable, devices.

And, this is only the beginning. Hewlett-Packard is committed to continuing its quality support of HP-IL. The devices that are compatible with the HP-41 as a mainframe controller will be compatible with future hand-held computers and personal computers with input/output capabilities. Many HP divisions—in the instrument and computer areas—will be introducing HP-IL devices.

We have enough space to give you only a small taste of the broad capabilities of HP-IL. See your local HP Dealer for a look at the new HP-IL system, and see if it will meet your challenge; we’ll bet it can—and does!

Three New Modules Introduced

Along with HP-IL, Hewlett-Packard introduced three new modules for the HP-41 System. These modules serve to expand the conveniences of the HP-41, both on its own and as a mainframe controller of HP-IL.

TIME MODULE

The new HP 82182A Time Module gives you the ability to incorporate precise time and date into your calculations. With this module, your HP-41 can be a clock, a calendar, a stopwatch, an alarm, and there’s much more.

You can set up to 253 separate alarms in the HP-41 (depending on the amount of memory available), and any alarm can be set to repeat itself again and again after a desired time-interval. An alarm will activate whether or not the calculator is on. And, when you set an alarm, you can choose to make it either a tone alarm, a message alarm, or a control alarm. When a control alarm activates, the HP-41 “wakes up” and immediately begins execution of a specified program. This feature makes the Time Module a valuable component of any HP-41 controlled HP-IL system.

The Time Module uses a quartz crystal for dependable accuracy. And, with the module’s “built-in” programmable accuracy factor, your HP-41 can “fine tune” your Time Module, thus giving it a time-keeping ability that will amaze even the most scrutinizing of accuracy buffs.

There is no other hand-held computer like the HP-41. And now the HP 82182A Time Module takes the HP-41 one more step forward.
Corvallis Library Corner

The Users' Library is a service to HP-67/97/41 programmable calculator owners. As a member of the Users' Library, one of your major benefits is that you are in communication with HP calculator users all around the world. Programs that are the result of many hours of brain-work by fellow HP calculator users are yours at an almost insignificant price. And, although anyone may order programs from the Users' Library, there are countless advantages to becoming a member. Read on ...

LIBRARY SUBSCRIPTIONS (CORVALLIS)

There aren't many investments you can make that give you an immediate return of over twice the invested value, but a subscription to the Users' Library is an investment that does just that, and better. In the United States and Canada, the fee for a one-year subscription to the Users' Library is $20. *This $20 fee places you on the mailing list to receive the Catalog of Contributed Programs ($10) and one update, and the Programmers Reference Guide (available March 1: a $10 value). Plus, you will presently receive a coupon good for four free programs, each program valued at $6. And, for the year of 1982, HP KEY NOTES will be sent to you free ($5 value) if you are a member of the Users' Library. Now, if you get out your HP calculator and total these figures, you will find that for an initial investment of $20, you get a package with a monetary value of $49. And the monetary value is only a small part of the true value of being a Users' Library member.

If you live outside the U.S. or Canada, the fee for a one-year subscription to the Corvallis Users' Library is $30* because of considerably higher postage and handling charges. Though you don't double your investment here, you still have everything to gain by becoming a Users' Library member.

And, you have a choice of how you renew your subscription. You can pay either the full subscription price ($20 in the U.S. and Canada, $30 elsewhere) and receive a coupon for four free $6 programs ($24 value), or if you don't need the four free programs, you pay only half of the original subscription price ($10 in the U.S. and Canada, $15 elsewhere).

You can subscribe to the Users' Library by using the form on page 15 or you can charge it to your major credit card over the phone. (Call 800-547-3400, except from Alaska and Hawaii; in Oregon call 503-758-1010.)

The greatest advantage of Library membership is being able to choose from a large collection of software that is immediately ready to serve you in your application. The savings in time and effort are worth much more than the small membership fee.

You also should look into the possibility of the Library fee being income tax deductible. You might even be able to deduct the cost of some purchased Library programs.

ORDERING PROGRAMS

HP-67/97 and HP-41 programs featured in KEY NOTES are now available from both the Library in Corvallis and the Library in Geneva. Readers in Europe should order from Geneva (address on back cover) to get quicker service. Readers elsewhere should order from Corvallis, whose programs and each program includes documentation and prerecorded magnetic cards; for HP-41 programs, this $6 price includes bar code.

Whenever possible, use the Users' Library Order Form in your Catalog of Contributed Programs to place orders for programs you see in KEY NOTES. If you do not have an order form, a plain piece of paper with your name and address and the program numbers you desire is certainly adequate. Make certain that your address is legible and complete.

Mail your order and a check or money order to the Corvallis or Geneva address shown on the back cover of KEY NOTES. Don't forget to include your State or local taxes. Or, in the U.S., you can place your order by calling toll-free: 800-547-3400, except from Alaska and Hawaii (in Oregon call 503-758-1010).

When ordering from outside the U.S., attach your payment to your order. Much time is wasted and orders are held up, trying to match orders and checks that are sent in separately. Your payment can be in the form of a Certified Order, Foreign Draft, or the equivalent. Any payment must be in U.S. dollars, drawn on a U.S. bank, otherwise it will be returned to you. Another option for payment is to use such major credit cards as American Express, VISA, or MasterCard.

Orders are usually shipped within 2 working days after they are received in Corvallis. However, if you need a program yesterday, call us today at 503-757-2000, extension 3371. Although we can't get it to you yesterday, we'll do our best to get it in the mail today.

SUBMITTING PROGRAMS

Programs submitted to the Users' Library should be on Hewlett-Packard standard Library submittal forms, or they should include, at least, the documentation required by those forms. To maintain the high quality of the programs submitted to the Users' Library, we encourage you to...
HP Computer Museum

www.hpmuseum.net

For research and education purposes only.
closely follow the Users' Library Contributor's Guide for the HP-41, HP-67, and HP-97. Complete and orderly documentation is essential to ensure the acceptance of a program into the Library.

We also encourage you to read the ongoing KEY NOTES column, "In the Key of HP." This column addresses some of the things we look for when we are reviewing programs that are submitted to the Users' Library.

Programs that are submitted to the Library for the HP-67 or HP-97 must include magnetic cards, and HP-41 programs must include either magnetic cards, reproducible bar code, or a data mini-cassette for use with the new HP 82161A Digital Casset Drive. (The cassette will be returned to you.) It would take far too long to review and check all the many programs submitted if we had to key them in by line by line. Also, there is always an increased chance of error when someone keys in handwritten keystrokes.

The management of the Users' Library reserves the right to reject programs which, in its opinion, do not represent a significant contribution or which are too poorly or insufficiently documented or are not otherwise appropriate for the Library.

CURRENT LIBRARY NEWS
(CORVALLIS)

January 1982 marks the tenth anniversary of Hewlett-Packard personal computing products. Although the Users' Library is a little younger, we are going to celebrate in a big way! Our most exciting news is for our authors. Now, they can make "points" with the Library! For every submitted program accepted by the Library, we will award the author one point. These points are redeemable for Hewlett-Packard accessories AND calculators. One point may be redeemed for a Solutions Book, one data cassette, or a custom keyboard--just to name a few of the items available. One point is also redeemable for the traditional "four free $6 programs coupon," or save the points and redeem them for such large items as an HP-41CV or even an HP-85 Personal Computer! The complete list of products available for the "point" system will be sent out with each accepted submittal. (This list is available from the Library upon request.)

NEW LIBRARY CONTEST

To further celebrate our tenth anniversary, the Library is sponsoring another contest. Beginning March 31st, and through August 31, 1982, the Library will award eight new HP 82162A Time Modules and either two new HP 82161A Digital Cassette Drives or two new HP 82162A Thermal Paper Printers (including HP-IL Module) to the authors of the ten programs judged best over the most outstanding month by our review committee. The programs will be judged on merit with the same guidelines as used in the last contest. For documentation forms, or further information, contact the Users' Library.

NEW TAXES SOLUTIONS BOOK

As unpleasant as tax time can be, your HP-41 is again equipped to help you through the paperwork. The HP-41 1981 Taxes Solutions Book (00041-90463) will be available February 1 and will cost $12.50.* Contact your local HP Dealer, or send your order directly to the Users' Library. If you order through the Library, include a $3.50 Handling Charge and any applicable State and/or local taxes.

ORDER STATUS ETC.
(CORVALLIS)

The Library is remaining current on orders and coupons, thanks to a great staff (that always seems to include ambitious temporary help). Remember, call the Library directly--503-757-2000, extension 3371 NOT TOLL-FREE--and your order will ship that same day (credit card or purchase orders only).

Our quantity discount offer was so popular that we are extending it through our tenth anniversary year. Order six or more Library programs, and deduct 25% (Library programs only).

Programs are now available from the Library on a data mini-cassette for use with the HP 82161A Digital Cassette Drive. The mini-cassettes are $9.50* each, with a program order from the Library, plus the price of each program requested. (For example: One cassette plus one program -- 9.50 + 6.50 = $16.00.) Take advantage of the quantity discount and fill a cassette today. Each cassette will hold up to 250 programs, depending on program length. The Library is here to support Hewlett-Packard programmable calculator owners. If you have suggestions for future Library services, let us know.

NEW PROGRAMS (CORVALLIS)

Here are some recent submittals to the Corvallis Users' Library. All of the programs featured in this issue are available worldwide, but before your order, be sure to read (above) "Ordering Programs." And, remember that where additional Memory Modules are listed as necessary to a program on the HP-41, you do not need them if you are using an HP-41CV or a Quad-RAM.

(41) Particlet Removal Cost #010100C
(Price: $8*)

The costs are determined for cleaning particulate matter from stack gas by electrostatic precipitation or fabric filters. Inputs include cost parameters, gas flow rate, percent particulate removal, fabric air-to-cloth ratio, and gas temperature. The flyash resistivity, ESP plate area, bag life, and baghouse pressure drop are estimated.

Required accessories: 3 Memory Modules, and a printer is helpful. (646 lines, 1618 bytes, 16 pages)

Author: Norman S. Charles
Houston, Texas

(41) Smooth Earth Diffraction #01085C
(Price: $8*)

The Smooth Earth Diffraction program predicts the radio propagation loss relative to free space for smooth earth conditions, or for conditions varying smoothly from uniform over a radius of the earth's radius. The program has a self-check for validity. Inputs include data on the effective earth radius. Required accessories: 1 Memory Module. (356 lines, 707 bytes, 27 pages)

Author: John L. Roth
Newbury Park, California

(41) Architectural Perspective #011220C (Price: $8*)

This program calculates two-point perspective views. Data may be input directly, or up to 256 data points may be stored in memory and/or written on magnetic cards. Data is grid-based; input and output grids may be dissimilar. Heigths may be input as grid values or as elevations (in feet or meters). Required accessories: 1 Memory Module. (269 lines, 476 bytes, 12 pages)

Author: Daniel R. Tindall
Minneapolis, Minnesota

* U.S. dollars. Orders from anywhere outside the U.S. must include a negotiable check (or money order), in U.S. dollars, drawn on a U.S. bank. All orders from anywhere outside the U.S. must include an additional 10 percent fee for special handling and air mail postage. For example, an order for two programs -- $16.50 + $1.20 = $17.70 total. If you live in Europe, you should order KEY NOTES programs directly from the Genesee UPLC, but make certain you make payment as required by Users Program Library. Even so, $8 fee is good only for orders to the Corvallis Library.
(41) Library Contest Winners Announced

In KEY NOTES V5N2 we announced the Users' Library Program Submittal Contest. In the following issue, V5N3, we announced the winners for the month of September. In this issue, we have the winning programs for October and November.

As you know, three programs were to be chosen on merit each month. You will notice that four programs are featured as the winners for the month of November. Two of these programs were contributed by the same author, and we chose to feature the same author, and we chose to feature winning programs for October and November. Notice that four programs are featured as the winners. Any mechanical engineer would be at a loss without these programs—Ed.

(41) Analysis of Laboratory Strength Test Data #67000-99952 (Price: $10*)

This package is made up of nine inter-related programs that deal with the analysis of data obtained from laboratory rock strength tests. Three programs take the Mohr-Coulomb failure criterion to determine angle of friction and cohesion. Three programs deal with nonlinear failure analysis of intact or jointed rock. One program develops the Mohr envelope, one determines material constants, and one tabulates principal stresses. Programs can be run together without re-entry of data. Programs run with or without the printer; a neat printout format is used. For those with only 3 Memory Modules, a longer program is described. Required accessories: 4 Memory Modules. (862 lines, 1796 bytes, 43 pages)

Author: John L. Gilby

Maidenhead, Berkshire, England

(41) Gear Mesh Design-Spur Gears #67000-09953 (Price: $10*)

Given a minimum of basic gear information, this program, calculates the data required to design a meshed pair of full-depth involute spur gears. Outputs include testing pitch ratio, backlash, contact ratio, distance between centers, and more. Also, this versatile program allows the user to manipulate the design through various inputs in order to customize the gear pair. Any potential design errors are flagged for user decision. This program does not work on the HP-41. (411 lines, 39 pages)

Author: Michael R. Cascini

Cedar Rapids, Iowa

(41) Sheep Production Model #67000-99954 (Price: $10*)

This program simulates both physical and financial aspects of sheep flock management. This allows users to compare differing management strategies and different flock types and, from this information, operate their flock more efficiently. This program does not run on the HP-41. (1116 lines of programming on 5 cards and over 80 pages of documentation)

Author: John Pauley

Tasmania, Australia

(41) Physical Property Estimation #67000-99955 (Price: $10*)

This program will calculate estimates of the point properties—critical temperature, critical pressure, critical volume, andacentric factor. Plus, the temperature correlated estimates of liquid density, heat of vaporization, vapor pressure, and surface tension, and the liquid and vapor properties of viscosity, and heat capacity also are calculated. Inputs required are the molecular weight, normal boiling point, and a molecular weight of the molecular structure. Required accessories: 4 Memory Modules. (987 lines, 2087 bytes, 34 pages)

Author: Robert Wooley

Midland, Missouri

(41) Buttress Design #67000-99951 (Price: $10*)

Cut slopes in bedrock having an adverse direction of bedding (dip out of slope) are commonly stabilized through the construction of a fill material buttress. Soil parameters and slope dimensions are sized to prohibit translational failure parallel to the plane of bedding. Required accessories: 4 Memory Modules. (1066 lines, 1799 bytes, 33 pages)

Author: Stephen Milazzo

Long Beach, California

(Continued)
The Users' Library was swamped with an extraordinary number of program submit- tals in December. At the time that this issue was going into production, neither the December contest winners nor the Grand Prize winners of the three marvelous HP-86 Personal Computers had been determined. We will feature these winners in the May 1982 issue (V6N2), so please bear with us until then...

Custom Keyboards Announced

Hewlett-Packard recently announced the introduction of the HP 82504A Custom Keyboard. Its flexible membrane completely covers the existing HP-41 keyboard and provides the final, professional touch in customizing the remarkable HP-41 calculator. This new Custom Keyboard can be printed with any customer-designed nomenclature, including logos, trademarks, alphanumerics, and other special symbols. And up to five colors can be printed on each Custom Keyboard.

Obviously, we cannot economically produce such products as the new Custom Keyboard in small quantities of one or ten or even fifty. This new product is a special order item, and it comes in minimum quantities of 250. For more information about this exciting new product, contact your nearest Hewlett-Packard Sales Office.

(By the way, you can get a single Custom Keyboard—with the standard key configuration—by earning 1 point from the Users' Library!—Ed.)

In the Key of HP

Most of the ideas presented in KEY NOTES are contributed by you, and they represent the ways in which you approach solutions to programming problems. This column addresses some of the common inconveniences that the Users' Library finds in user-submitted programs. Also in this column, we answer some of the common questions that you ask, and we present some ideas that we think you will find useful.

In this issue, John Loux, a Technical Advisor in the Users' Library discusses application packs (ROM) for the HP-41, and the utility of the COPY function. Plus, we have added some handy tips near the end of the column.

PROGRAMS IN ROM

HP-41 application packs and custom program modules are general-purpose packages written either by Hewlett-Packard or independent groups. Their programs and functions are permanently written in plug-ins modules. These ROM-resident programs can be accessed and used in much the same way and for all of the same reasons that user-written programs can be used. Although, for all user-intensive purposes ROM (read only memory) programs are very similar to their RAM counterparts, they also differ in some important ways.

The acronym RAM stands for "random access memory" and is used most often when referring to the read/write memory of a calculator or computer. Loosely, random access means that information stored anywhere within memory can be accessed with equal ease. All user-alterable aspects of the HP-41 (programs, data, flags, the current SIZE, etc.) are maintained in RAM. ROM is similar to RAM in that it can be randomly accessed and is capable of maintaining the same kinds of stored information. Although ROM is capable of supporting many kinds of information, its read-only nature limits its usefulness in maintaining such information as data and status. Consequently, related functions are not supported. The two types of information that are supported by ROM are user-language programs and micro-code functions.

Except for certain aspects of their internal representations, ROM programs are identical to RAM programs. ROM programs can be run, single-stepped through, printed on a printer, and can be randomly accessed via the GTO (go to label) and GTO (go to step) commands. ROM programs cannot be traced, cannot be edited or deleted, cannot be positioned to by using CATALOG 2, and cannot be packed. In short, you can do nothing with a ROM program but run or view it while it still resides in ROM.

Because ROM is internally different from RAM, the HP-41 references it differently. One manifestation of this difference is seen in how the execution of a ROM program is represented in program memory. The program must be key in XEQ (AM) followed by the label character and ALPHA just as would be done if a RAM alpha label were accessed, but before the calculator stores the keystrokes as a program line, it searches its memory for the label in the order of the three catalogs; i.e., CAT 1—internal RAM, CAT 2—external ROM, and CAT 3—standard functions (internal ROM). If the corresponding label does not exist in CAT 1, the calculator translates the XEQ command into an XROM command before storing it as a program line. XROM's are provided so that the calculator will know exactly where to look for the label when the execution is performed, thereby decreasing access time. The ROM number and the function number within the ROM are recorded in the XROM statement and can be seen if the program step is viewed with the required ROM removed. The user will note that the corresponding process does NOT occur if a programmatic GTO is performed to a ROM label. Thus, every time such a GTO is encountered, the calculator must search CATALOGs 1 and 2, taking more time. Coupled with the fact that the GTO function will leave the program pointer in ROM (a generally undesirable occurrence), it becomes obvious that the use of GTO to access ROM programs should be limited.

The other kind of information that is supported by ROM is the microcode function. These functions are virtually identical to standard (CAT 3) functions, and are ROM programs. They are invoked in the same fashion that standard functions are, via an XEQ or key assignment, and their mnemonics are displayed with no preceding XEQ or XROM when their respective ROM's are attached. Function mnemonics will revert to XROM's if their resident ROM's are not plugged-in to the calculator. Functions can be distinguished from programs in RAM but do in ROM, the function name precedes each program label.

COPY

There will be times when a ROM program will not be useful as written but would be if it were modified. In this instance, having a modifiable copy of the program in RAM is desirable. Fortunately, the HP-41 supports this action with the standard function COPY. The COPY function is not programmable.

When executed, COPY prompts for a global label resident in the ROM program of interest. The input label need not be the first nor the only global label in the program. The function then makes an identical copy of the entire ROM program in RAM (if there is room), beginning at step

* User language is that which the user implements when steps are keyed in program mode. Microcode is machine language; that low-level language that the machine actually implements when it performs an operation. Normally, the user cannot access or write functions in microcode.

** Tracing is the ability of all HP-41 compatible printers to list the executed steps and important intermediate results of a running program.
even if the preceding program is already terminated by an END and even if there is no preceding program. These solitary ROM-dependent programs are represented, including any XROM’s that are ROM-version in terms of the functions and programs that are used. This may or may not be desirable, depending on your needs. For example: if the program that is copied acts as a controller and calls ROM routines to do certain subordinate tasks, alterations to the in-ROM program may be made as long as they are compatible with the running of the called subroutines. On the other hand, if you desire to alter or write your own subroutines, you should replace the XROM program calls with appropriate XEQ statements that call your own routines. Because CAT 1 is searched before CAT 2 when a subroutine call is performed, your customized routine may have the same label as the ROM program label you are replacing.

Note that if you desire to COPY and run all or part of a ROM program without having the ROM physically attached, all XROM’s involved should be translated to XEQ’s and all called subroutines should be COPY’ed. Note also that any function (as opposed to program) calls must also be replaced by calls to user-written routines. If such a programmatic XROM is encountered without the ROM in place, the calculator will display “NONEXISTENT.” To verify that this occurrence is the result of a forgotten XROM, simply put the calculator into program mode at the point at which the program stopped, and read the displayed step.

If the display “RAM” occurs, then the program you have just tried to COPY has either already been loaded into RAM (perhaps as a portion of a program that was already COPY’ed using another of its global labels) or another program of the same name already exists in RAM and uses the same global label.

THE USERS’ LIBRARY
COPY’ed programs are acceptable to the Library as long as they represent a significant change from the original program. COPY’ed programs should be documented as such, with the ROM name and any duplicate labels given prominence. Highlights of the differences between the contributed program and the ROM program should also be given.

Programs that make use of ROM routines as subroutines are also acceptable. The ROM functions and programs that are used should be listed and the ROM requirement must be given under the “Necessary Accessories” heading.

Following, now, are the tips we promised at the beginning of this article.

Q: What is the shortest and fastest way to divide by 100 in a program?
A: There are three frequently used methods for dividing by 100.

1. 100 / length: 4 bytes
2. 1E2 / length: 4 bytes
3. 1. / length: 2 bytes

Method number 2 is faster than method number 1, but method number 3 is the shortest and fastest way to divide by 100 in a program. You can use this “percent” method to divide by other numbers, too. For instance, 1000 ▼ becomes .1 ▼; 50 ▼ becomes 2 ▼; and, 500 ▼ becomes .2 ▼.

ADD A LOCAL LABEL
Many of the routines and programs that we receive in the mail have in them GTO statements that call global labels in the same program. For example, we wrote this simple counting program:

01 LBL “COUNT”
02 VIEW X
03 1
04 +
05 GTO “COUNT”

This routine can be shortened by 4 bytes, and the execution time noticeably reduced, by adding a local numeric label (00-14) and replacing that global label GTO in line 05 with a local label GTO. Choosing to use LBL 01, we have:

01 LBL “COUNT”
02 LBL 01
03 VIEW X
04 1
05 +
06 GTO 01

It is always advantageous to use local labels when making jumps within a program. Global labels should be reserved for jumping between programs and for making routines and programs accessible from any part of program memory.

In short, don’t use GTO “a global label” in a program if that global label appears in that program. Instead, add a local label before or after the global label and use: GTO “the local label.”

For more details on this subject read V5N2, “In The Key of HP.”

WHAT IS IT?
“Synthetic Programming,” as applied to the HP-41C or HP-41CV, is the use, in programs or manual operation, of any of the following: synthetic functions, synthetic key assignments, and nonstandard alpha strings and labels. The word “synthetic” derives from the user-initiated synthesis of HP-41 instruction bytes into combinations that are not available with normal keystrokes.

As a simple example of what we have thus far discussed, consider nonstandard alpha strings. Each HP-41 instruction byte has a corresponding alpha character. The keyboard has at least 59 different characters, and 49 of these characters have been assigned to the HP-41 display. For example, as users of the HP-82143A Printer/Potter function BLDSPEC can attest, the HP-41 display is capable of forming additional characters. And so, using Synthetic Programming techniques, any of 19 additional characters can be included in alpha displays, program text lines, and global label names. Furthermore, any of the 128 printer characters can be represented in a program text line, which can result in a significant savings in program bytes through reduced use of ACSPEC and of flag 13. But that’s a simple example. A more elaborate example of Synthetic Programming follows...

HOW DOES IT WORK?
The program “BYTE” provides a quick and precise means of computing the number of bytes in a user program (or between any two points in program memory), without use of the printer. At each of two different program lines, the user presses a key that he/she has assigned to the synthetic function “RCL b” (which recalls the value of the internal program counter to X). Then, “BYTE,” in an execution time of less than 3 seconds, returns to X the number of bytes between the two program lines. This very useful result is impossible to obtain using normal HP-41 functions.

Look carefully at lines 10, 11, 12, 13, 26, and 32. Of this group, line 11 is a nonstandard program text line, as described above; line 12 is a typical “1 E3” program line, shorn of the superfluous “1” (thus saving a byte); the rest are new two-byte lines, usually called “synthetic functions.” These functions provide access to the so-called “system scratch registers,” which are a group of 16 registers (track 1 of a card reader WSTS card) including the (Continued)
user RPN stack, the ALFA register, the program counter and subroutine return stack, the 56 user and system flags, key assignment information, and the current memory allocation data. For example, line 13 causes the exchange of the contents of the X-register with those of the d-register, which contains the 56 user and system flags. The name “d-register” comes from the display of the associated functions. The “x<>” prefix and the “d” postfix—seen normally only in “LBL d”—have been combined into a synthetic function. There is no normal function postfix associated with the program code that results in the “t” in line 10—the use of the printer symbol “t” is just an accident. (In the HP-41 display, line 10 shows as “STO M.”) Lines 13 through 26 take a number from X, swap it with the contents of the flag register, change its value by manipulating individual binary bits (i.e., by setting and clearing flags), and finally restore it to X while returning all flags to their original states.

There are numerous other examples of the capability of Synthetic Programming to expand the already impressive power of the HP-41. This makes it desirable for the Users’ Library, in its role of providing instruction in Synthetic Programming, to accept programs containing synthetic code, but only with the following reservations:

1. This new policy of Hewlett-Packard (HP) does not constitute an endorsement or recommendation of Synthetic Programming. Hewlett-Packard will not “support” Synthetic Programming, neither by guaranteeing that synthetic functions will operate on all present and future HP-41’s, nor by providing instruction in Synthetic Programming to customers. HP will, however, refer customers to independently available references on Synthetic Programming (see below).

2. Programs containing synthetic code will be specifically and clearly identified in the Users’ Library Catalog or in KEY NOTES, to warn potential users that the code cannot be keyed into their calculators by using standard techniques. However, customers not familiar with Synthetic Programming techniques will be able to use the card reader or wand to enter the programs into their calculators.

3. Program authors must include in their program documentation a clear and precise identification of all synthetic program lines, including specifications of the byte structure of the lines. And all inquiries about the programs will be referred directly to the authors.

WHERE CAN I GET MORE INFORMATION?

In KEY NOTES V4N3p8 we reviewed the book: Synthetic Programming on the HP-41C, by Dr. William C. Wickes. The book describes the complete theory and application of Synthetic Programming, starting from the beginner’s standpoint. This 96-page book is $11.00 postpaid, by surface mail, anywhere in the world. For air mail, add: U.S., Mexico, and Canada $1.00; for Europe and South America $2.00; for elsewhere $3.00. Order it from Larken Publications, 4517 N.W. Queens Avenue, Corvallis, Oregon 97330 U.S.A. Make sure your check or money order is in U.S. dollars, drawn on a U.S. bank.

Another source of information about Synthetic Programming is the PPC Calculator Journal, published by the independent users’ club, PPC. For more information about PPC and a sample issue of the club’s newsletter, send a self-addressed, large (folded) envelope (9 x 12 inches; 23.8 x 30.5 cm) with first-class postage for 2 ounces (56.7 grams) to: PPC Calculator Journal, 2545 W. Camden Place; Santa Ana, California 92704 U.S.A. If you live outside the U.S., make sure you include a legitimate address label and international postal coupons for 56.7 grams (2 ounces). A letter is not necessary and will only slow the response.

A third reference for Synthetic Programming is the book reviewed in KEY NOTES V5N3p9. It is: Calculator Tips & Routines Especially for the HP-41C/41CV, and it was edited and compiled by John S. Dearing, a member of PPC and a resident of Corvallis, Oregon. The book is 136 pages and mainly a fabulous collection of tips and routines from past KEY NOTES, HP manuals and books, the PPC Calculator Journal, and other sources. It includes routines that contain synthetic code, but it is not a treatise on Synthetic Programming. The book is $15 postpaid to the U.S., Canada, and Mexico; $20 air mail postpaid elsewhere. Make your payment is a check or money order in U.S. dollars, drawn on a U.S. bank. Order it from: Corvallis Software, Inc.; P. O. Box 1412; Corvallis, Oregon 97339 U.S.A.

If you are in a hurry to get one of these two books, try calling your local college bookstore or your local HP Dealer before you order by mail. Some of these stores are now carrying calculator books.

"Free" One-Year Subscriptions …

At one time, several years ago, we did offer a “free one-year subscription” to HP KEY NOTES. However, for many reasons, that offer was soon changed to read: “KEY NOTES is published periodically and is presently free to you, an HP-41 owner.” Or, in the case of earlier calculators, it states: “…to the owners of HP-67 and HP-97 calculators.”

We bring this to your attention because of the recent addition of a subscription fee for KEY NOTES. Some readers have written to question us about the balance of their “free one-year subscription,” and we have had to remind them that the card formerly packed with each new card-programmable HP calculator does NOT offer a “one-year” subscription.

Today, and in the foreseeable future, the only free subscription to KEY NOTES is the one offered if you are a member of the Corvallis Users’ Library in 1982 or if you join the Users’ Library in 1982. We have not made commitments past 1982 because of rapidly changing postage, freight, and printing costs. Perhaps later this year we can be more specific about multi-year subscriptions at reduced rates. But don’t worry, because we will surely let you know of any changes in KEY NOTES.
The Issue on Back Issues

Because many new owners of HP-41 hand-held computers want to retrieve the information presented in earlier issues of KEY NOTES, we will make back issues available starting March 1, 1982. However, because it is economically and physically unfeasible to reprint all of the back issues of KEY NOTES, we are going to offer from hand-held computers want to retrieve the point should satisfy most new subscribers to KEY NOTES.

Below are the contents of each available back issue, followed by a price schedule.

V5N3 SEP-DEC 1981 (16 pages)
- Library Corner
- First Contest Winners Announced
- Toward More Secure Bar Code
- PIC Conference Held Here
- Library Contest Continues
- In the Key of HP-41 Functions
- Book Reviews
- Back Issues of KEY NOTES
- Tenth Anniversary Calendar Ready
- Routines, Techniques, Tips, Et Cetera
- KEY NOTES Subscription Plan

V5N2 MAY-AUG 1981 (16 pages)
- Library Corner
- Do You Really Know Your HP-67/97?
- HP-41 “Bush Computer”
- Library Contest Announced
- More Software = More Solutions
- In the Key of HP (Discussion on Labels)
- Magnetic Card Erase
- Petroleum Fluids Pac Released
- Routines, Techniques, Tips, Et Cetera
- Tenith Anniversary Calendar Announced
- KEY NOTES Subscription Plan

V5N1 JAN-APR 1981 (16 pages)
- Library Corner
- KEY NOTES Going to Subscription
- Quad RAM Questions
- Generating Bar Code
- HP-41 Flags—Part 2
- Custom Services Sells Solutions
- Routines, Techniques, Tips, Et Cetera
- HP-41 Subroutines
- HP-41 Function List

V4N3 SEP-DEC 1980 (12 pages)
- Library Corner
- “Petals Around the Rose”
- HP-41C Flags—Part 1
- Is the HP-67 Dead?
- “Roll!” Your Own Bar Code
- “I Owe It All to My HP”
- It’s “That” Time Again!
- Book Reviews
- “25 Words” (More or Less!)
- New Products, New Prices

V4N2 JUN-AUG 1980 (12 pages)
- Wand Functions
- New HP-41C Power Source
- Library Corner
- How Small Can You Write?
- Efficient Use of HP-41C Status, Data, and WALL Cards
- A Special Program (HP-67/97)
- The Wizard of Programming
- Book Reviews
- “25 Words” (More or Less!)

V4N1 MARCH 1980 (12 pages)
- Important HP-41C Information
- Fitting 67/97 Programs Into the HP-41C
- “25 Words” (More or Less!)
- Russian Calculator’s
- Library Corner
- About Batteries ... Continued
- Accessories Hot Line
- Indirect Addressing
- Book Reviews
- We Get Letters

V3N4 NOVEMBER 1979 (12 pages)
- Library Corner
- HP-41C Tips and Techniques
- (67) Twenty-Element 4 X 5 Matrix
- Book Reviews
- HP-41C Tips From an Owner
- Randomly Yours
- We Get Letters
- “25 Words” (More or Less!)
- HP-41 Owner’s Handbook Addendum

V3N3 AUGUST 1979 (12 pages)
- The HP-41C Defined
- A User’s View of the HP-41C
- The Designer’s View
- HP-67/97 Compatibility
- Software for the HP-41C
- Library Corner
- Another Excellent “Calculator” Book
- Random Numbers, Means, Regressions etc.
- About Batteries
- More About Merging (HP-67/97)
- “25 Words” (More or Less!)

For the convenience of “newcomers,” the column “25 Words (More or Less!) was the forerunner of the present column, “Routines, Techniques, Tips, Etc.” These columns contain programming information for the HP-67/97 and the HP-41.

Prices for KEY NOTES back issues are as follows. All prices include first-class or air mail. Payment must accompany your order and must be a check or money order in U.S. dollars drawn on a U.S. bank. Or you may use your American Express, VISA, or MasterCard account; be sure to include your account number and card expiration date. Your order will be promptly mailed in an envelope.

<table>
<thead>
<tr>
<th>NO. OF ISSUES</th>
<th>U.S.</th>
<th>CANADA</th>
<th>ALL OTHER COUNTRIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$2.00</td>
<td>$3.50</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$3.50</td>
<td>$5.00</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$5.00</td>
<td>$6.50</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$6.00</td>
<td>$9.00</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$7.00</td>
<td>$9.00</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$8.00</td>
<td>$10.00</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>$9.00</td>
<td>$11.00</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>$10.00</td>
<td>$12.00</td>
<td></td>
</tr>
</tbody>
</table>

Remember, these back issues will NOT be available until March 1, 1982.

KEY NOTES Corrections

Before the V5N3 issue of KEY NOTES, our collection of stamps from Ireland and Scotland was a little low. But, thanks to an error that appeared on page 12 in column a, we now have plenty of Irish and Scottish stamps. It is great to know that KEY NOTES is read carefully by so many people throughout the world, especially those who know where Loch Ness actually is located!!

Also, in column a on page 12, there is a typographical error in the second contribution by Roland Waldi. The trigonometric keystrokes for the algebraic function X/√(1−X²) should be SIN⁻¹; TAN⁻¹. And, when you are using these simplified trigonometric expressions, remember that X must be less than 1 if 1−X² appears in the algebraic expression or if your calculator is set to radians (RAD) mode.

In Vally Lambrechte routine (p 14a), line 11 should be the card reader function RSUB. That XROM 30,04 is the XROM code for this function, as you can find on page 32 of your HP 82104A Card Reader Owner’s Handbook.

Cube-Puzzlers Rescued!

In the last issue (V5N3p16) we told you about, and showed you, “Kolb’s Cube.” (Got a lot of comments about it, too!) So what does one do for an encore to that remarkable creation? Fortunately, we received an absolutely remarkable HP-41 program that “solves” Rubik’s Cube. (We have several, but this one is superb.) And if you recognize the author’s name, you’ll realize he is one of the winners of the Users’ Library Program Submittal Contest, reported elsewhere in this issue.

Congratulations, Mr. Gilby, your program not only works but also shines as a living example of excellent documentation. Here’s the abstract.

(41) Rubik Cube Solution #01342C (Price $12*)
Rubik’s magic cube has taken the world by storm, recently. This program solves the famous cube from any position. The user enters the initial colours of the faces and the HP-41 proceeds to solve the cube, using three subroutines. The output is a series of instructions informing which face should be rotated. The program is fully illustrated, and the notation used is explained so that it will now be simple to solve the cube. This solution will not break any world records, however, because it is relatively slow.

Required accessories: 4 Memory Modules and Card Reader (Printer optional); and, of course, a Rubik Cube! (1213 lines, 1918 bytes, 36 pages)
Author: John L. Gilby
Maidenhead, Berkshire, England

* U.S. dollars. See note at bottom of page 9.
Why not sell your software through Hewlett-Packard Dealers?

- Can you identify needed professional solutions?
- Can you write quality software?
- Do you have the resources (time, media duplication, order taking, brochures, etc.) to sell your solutions in volume through HP Dealers?
- Can you support your product after the sale?

If so, you may qualify for the HP PLUS Program (KEY NOTES V5N2p5c). First Principles Software did. First Principles is a new, full-time venture (about a year old) for Pat Imbimbo, a registered engineer. His seven Civil Engineering programs for the HP-41 deal with such problems as hydrology and retaining wall construction. Pat is looking to build on these initial programs to offer a range of software in Civil Engineering and construction. (See the new Users' Library Catalog for more information on these programs.)

HP PLUS software was developed by an independent software supplier for operation on HP computer systems. The supplier is solely responsible for its software and support services. HP is not the manufacturer or co-developer of such software or support. HP disclaims any and all liabilities for and makes no warranties, expressed or implied, with respect to this software. Distribution of this product or information concerning this product does not constitute endorsement of the product, the supplier, or support services. The customer is responsible for selection of the software he or she purchases.

HP is interested in all professional HP-41 solutions. Of particular interest are ware-based inventory, cassette-based statistics, sales management, in-flight aviation, taxes, and agriculture. Interested parties should contact:

- Jack Peters (Dept. 5360)
- Hewlett-Packard Company
- 1000 N.E. Circle Blvd.
- Corvallis, OR 97330
- (503) 757-2000 Ext. 2207

Letters to KEY NOTES

When you address letters to KEY NOTES, you should refrain from including anything not associated with the newsletter. Questions about the calculator or its operation should be addressed to Customer Support and questions about the Users' Library should be addressed to that function. Also, questions about future products cannot be answered; Company policy permits me to discuss only those products that have been released. Federal regulations also prohibit discussing future products.

Letters to the editor should be addressed to:

- Henry Horn, Editor
- HP KEY NOTES
- Hewlett-Packard Co.
- 1000 N.E. Circle Boulevard
- Corvallis, Oregon 97330 U.S.A.

We cannot guarantee a reply to every letter, but we do guarantee that every letter will be read by the editor or technical editor (Ted Wadman), and as many as possible will be answered in KEY NOTES or in a personal response. Please be sure to put your return address on the face of your letter. Letters sometimes get separated from envelopes.

READER FEEDBACK

You send us many letters that extol the virtues of KEY NOTES, so we know that you like the newsletter. However, never hesitate to write and tell us about what you would like to see in a future issue—issues. We are open to all and any suggestions.

HP-67/97 Routines and Tips

This idea came to us some time ago from William Pinnick of Columbus, Ohio. It is applicable to many situations.

(67/97) One of the beautiful aspects of the HP-67 and HP-97 calculators is the ability to increment and decrement the l-register to control program flow and looping. This ability is significantly enhanced by indirect increment statements and indirect decrement statements for additional looping control.

As an example, I believe I have found the lowest possible number of statements necessary to control three levels of looping—only 18 steps! Assuming all loops begin at the same value and count down, a unique exit is achieved by the DSZ step for the three counters: l, primary register 0, and secondary register 0. The positions of these three counters make them uniquely suited for this purpose; thus, the program is:

```
*LBL3 STO 0
*LBL4 DSZ
STO 0
STO 0
STO 0
STO 0

Beginning after LBL2, key in the body of the nested loop, making calculations based on the changing values of the l-register, primary register 0, and secondary register 0. The l-register changes most rapidly, primary register 0 second, and second register 0 changes most slowly. After the calculations, close the loops with:

STO 0

The initial counter value must be in the X-register when the nested-loop begins.

This routine was sent to us from Benton, Illinois, by Robert M. Blake. It refers back to the last issue of KEY NOTES (V5N3).

(67/97) In response to David Whyatt's request (V5N3p12c), perhaps the following routine will be beneficial.

```

The major advantages of this routine being it is shorter by 11 program lines. Also, it needs only two labels, one storage register (l), and it does not use flags. The time it takes to return a decimal number is equal to Mr. Whyatt's; however, whole numbers are returned much quicker.

(The purpose of this routine is to format data in the form Fg.x, meaning only 5 spaces will be occupied by the digits, the sign (if there is one), and the decimal point. Thus, 26.8842 is displayed as 26.88, -26.8842 is displayed as -26.8, and 2.68842 is displayed as 2.688. The format assumes X to be less than 10,000 and at least 0.00005. The field length can be changed by changing line 003; for instance, F7.X would require line 003 to be 6—Ed.)

Editorial

If you are reading KEY NOTES for the first time, welcome to our elite group. If this is your first "paid-subscription" issue, thank you for your faith in, and support of, KEY NOTES. We have some interesting surprises for you in 1982, and I am certain that you will find your investment in KEY NOTES a wise choice.

Mr. Edward R. Bettinardi of Denver, Colorado, tried a recommendation from V3N1p6c and found to his dismay that it didn't work. We are grateful that he took the time to inform us of his discovery. In the referenced issue, we reported on an eraser kit that removed "permanent ink" from magnetic cards. By "permanent," we meant "India ink," used in drawing and drafting trades. Unfortunately, that eraser kit removes only India ink. It will not touch such inks as that used in Sanford and some Pilot and Schwann felt-tip pens. When they named those inks as "permanent," they were serious! Thanks, again, Mr. Bettinardi, for telling us about that problem.

```
The routines and techniques furnished in this column are contributed by people from all walks of life and with various levels of mathematical and programming skills. While the routines might not be the ultimate in programming, they do present new ideas and solutions that others have found for their applications. You might have to modify them to fit your personal application.

It is probable that you will find this next routine to be a useful addition to your catalog of programs. It was submitted by Serge Drogi of Stavold, France.

(41) Just a word to the HP-41 users. It is possible to calculate a probability with the Binomial Law without using any register outside of the stack. So, this program will be a good example of the advantages of RPN to all users.

The expression is:

\[ P(k) = \frac{n! p^k (1-p)^{n-k}}{k! (n-k)!} \]

It is interesting to search for what happens in the stack. At the beginning the stack must be set up with:

- \( X: k \)
- \( Y: p \)
- \( Z: n \)

At the end, the answer, \( P(k) \), is in \( X \).

John Hendricks, who lives in San Carlos, California, developed this quick and useful routine to enhance your HP-41 printouts.

(41 with printer) This routine converts and prints, with an HP 82143 Printer/Plotter, a degrees, minutes, and seconds X-register value to the form DDOMM'SS.F" without utilizing any storage registers. For HHhMM'SS, substitute 105, ACCHR for lines 08 through 15.

Here is a routine that is 83 bytes long, but has the potential of saving many registers in a program that handles a lot of data. It is similar to a routine, by Leonard Cordwell, that we printed in V5N2. This version was sent to us by Nai Chi Lee of Stony Brook, New York.

(41) This routine can pack positive integers from 0 to 999,999. (However, due to round-off error in LOG, the two numbers must not both be 999,999.) It is 83 bytes long, but can be reduced by using local labels. To pack, place number abcd in X and uvwxyz in Y. Then XEQ "IN." The resulting number in X is of the form: a0bcd0uvwx.

If the number uvwxyz is less than 100,000, it is normalized by adding 1E5 to it. This is flagged by the negative sign.

To unpack, just place the "combined number" in X and XEQ "OUT." The original two numbers are returned to X and Y respectively.

In V5N2p12c we published a routine, DV, by William J. Quinlan, Jr. of Evanston, Illinois, that creates a divider bar of any length composed of any character on an HP-41 printout. Not satisfied with the methods used in the routine, Klaus Veil of Zurich, Switzerland, rewrote it, incorporating Swiss workmanship and the characteristics of flag 22.

Here is a routine that will please those of you who own a printer. It is a simple but useful routine that was sent to us from Piacenza, Italy, by Steve Tendon.

(41 with printer) This "special-built-in" routine makes special character building easy. First of all, I have named each dot of the print column (see page 62 of your printer manual) with a letter, like this:

- A
- B
- C
- D
- E
- F
- G

Instructions for use are as follows:

1. Load program.
2. USER (on); ASN "SPBLDSP" and "BLDSPC" to, for example, SIN and COS, respectively.
3. Press SPBLDSP.
4. Press the letter-keys that correspond to the dots you want to darken (if it is a blank column skip this step).
5. Press BLDSPC.

John Hendricks, who lives in San Carlos, California, developed this quick and useful routine to enhance your HP-41 printouts.

Here is a routine that will please those of you who own a printer. It is a simple but useful routine that was sent to us from Piacenza, Italy, by Steve Tendon.

(41 with printer) This routine converts and prints, with an HP 82143 Printer/Plotter, a degrees, minutes, and seconds X-register value to the form DDOMM'SS.F" without utilizing any storage registers. For HHhMM'SS, substitute 105, ACCHR for lines 08 through 15.

Here is a routine that is 83 bytes long, but has the potential of saving many registers in a program that handles a lot of data. It is similar to a routine, by Leonard Cordwell, that we printed in V5N2. This version was sent to us by Nai Chi Lee of Stony Brook, New York.

(41) This routine can pack positive integers from 0 to 999,999. (However, due to round-off error in LOG, the two numbers must not both be 999,999.) It is 83 bytes long, but can be reduced by using local labels. To pack, place number abcd in X and uvwxyz in Y. Then XEQ "IN." The resulting number in X is of the form: a0bcd0uvwx.

If the number uvwxyz is less than 100,000, it is normalized by adding 1E5 to it. This is flagged by the negative sign.

To unpack, just place the "combined number" in X and XEQ "OUT." The original two numbers are returned to X and Y respectively.

In V5N2p12c we published a routine, DV, by William J. Quinlan, Jr. of Evanston, Illinois, that creates a divider bar of any length composed of any character on an HP-41 printout. Not satisfied with the methods used in the routine, Klaus Veil of Zurich, Switzerland, rewrote it, incorporating Swiss workmanship and the characteristics of flag 22.

(Continued)
James LeMay, who lives in Houston, Texas, recently wrote to remind us that if we PACK and then compile our programs before recording them on cards, then our programs will execute faster when they are read into the calculator, because local label searches aren't performed in compiled programs. The easiest way to compile a program is to execute it several times, making sure to consider every local branch in the program. Another way that compiling can be done is to position the calculator to each GTO or XEQ statement that calls a local label, then press R/S; let the program run until the "goose" jumps ahead 1 step in the display, then again press R/S. After all of the local branches are compiled, the program is ready to record on a card.

However, you will be able to enjoy the benefits of recording compiled programs (more rapid execution) only if you do not PACK or GTO, after reading the program into the calculator.

When the HP-41 is running a program and it encounters a GTO or XEQ statement that calls a local label (00-99, A-J, and a-e), it searches ahead for the label, and then it records the distance to the label (in bytes) with the GTO or XEQ statement. This process is sometimes referred to as "compiling," and it speeds-up future executions of the program. (See VSN2p06c, "In the Key of HP," for more information on labels.)

Packing the program erases the recorded distances in GTO and XEQ statements. After PACKING, the first few executions of a program will generally take longer because the calculator must search for any local labels. When all of the GTO or XEQ statements have been executed once, the program is again compiled and the calculator doesn't have to search for local labels until the program is packed or lines are added.

Next, we have these comments from Anders Thorp, Sweden. They were contributed by Peter Jersholm.

(41) After having read KEY NOTES V5N1, I tested Patrick Shibili's "Scrolling-Routine" on page 12 and discovered this: Whenever a VIEW or AVIEW instruction in operation (the "flying goose" is replaced with something else), any ignored operational error (flag 25) causes the display to scroll to the right at each following label just like the "flying goose" usually does. This goes on until STOP, END, or PSE is executed.

However, the GTO "Y" instruction in Mr. Shibili's routine causes the HP-41 to search for the NONEXISTENT LBL "Y" before it continues. This delay can easily be avoided by replacing GTO "Y" with, say, RCL nn, where nn is a nonexistent register. Here, the HP-41 "knows" instantaneously that the register does not exist and, therefore, the display (max 12 letters) starts scrolling without noticeable delay.

(Again fast way to create an error (that clears flag 25) is SF nn, where nn is a nonexistent flag—Ed.)

Frank Wales, of Glasgow, Scotland, recently wrote to us to correct an error that appeared in KEY NOTES, V5N2.

(41) Having come across an error in the last issue that I didn't notice on first reading, I thought I had better tell you about it. It concerned what was said about testing complex conditions (VSN2p12c). Claude Roeltgen states that if you have two conditionals A and B and you wish to construct the relationship "IF A OR B THEN instruction;" then you can express this as: 01 inverse of A; 02 B; 03 instruction. This is correct. For example, the relationship: IF (X>Y) or (Y<Z) then XEQ 05, is created by:

01 XEQ(Y) (inverse of first condition)
02 FS?00
03 XEQ 05

However, Mr. Roeltgen also states that the relationship "IF A AND B THEN instruction" can be constructed by: 01 A; 02 inverse of B; 03 instruction. This is incorrect. The truth table would be:

A  B  instruction performed
0  0  0
1  0  1
1  1  0

while the truth table for the AND relationship should be:

A  B  instruction performed
0  0  0
0  1  0
1  0  0
1  1  1

(Very sharp eye, Mr. Wales. The shortest routine that I could come up with for the "IF A AND B THEN instruction" relationship looks like this:

01 inverse of A
02 GTO 01
03 B
04 instruction
05 LBL 01
and I'm anxious to see a shorter version—Ed.)

Recently, we received two letters dealing with the subject of root-finding routines. The first letter was sent to us by R. H. Miller of Oakland, California. Mr. Miller reminded us that the HP-41C STANDARD APPLICATIONS HANDBOOK has an error in the listing of the "Root Finder" program; steps 44 and 45 should be switched to result in: 44 IF 8; 45 X>Y. This error was corrected in the May 1981 printing of this handbook.

The second letter was from Fredrick Öberg of Linköping, Sweden. He enclosed...
a root finder routine that he uses with his HP-41.

(41) This routine is a very tiny root-finder, using the "Regular False" method. It is a useful routine that is a part of the normal status of my calculator. It will stop when an accuracy equal to the FIX is achieved. It requires two guesses. The function, in the form F(X)=0 is to be programmed into memory under the global label "Y". The keystrokes are: guess 1 ENTER, guess 2 XEQ ALPHA ROOT ALPHA. This routine has proved very useful in math tests at school.

01 LBL "ROOT" 17 RCL 03
02 STO 01 18 *
03 X<>Y 19 -
04 STO 02 20 X<>Y
05 XEQ "Y" 21 ENTER
06 STO 03 22 X<> 03
07 RCL 01 23 X=0?
08 LBL 00 24 GTO 01
09 VIEW X 25 -
10 STO 01 26 /
11 XEQ "Y" 27 RND
12 STO Y 28 GTO 00
13 RCL 02 29+LBL 01
14 + 30 RCL 01
15 RCL 01 31 RND
16 STO 02 32 RND

Now, from Rochester, New York, we have this contribution by Jeffrey Smith. This is a nice routine for obtaining a vector magnitude or the hypotenuse of a right triangle. It is a monadic function, meaning that it places X in LASTX and preserves the Y, Z, and T registers.

(41) Some of your readers who are interested in coordinate geometry might like the following routine, which will compute \( \sqrt{X^2 + Y^2} \). The Y, Z, and T registers are unaffected and the original X is placed in the LASTX-register. Pressing \( \sqrt{} \) while in user mode will initiate the computation. User-definable key \( \sqrt{} \) may be used to conveniently swap the X and LAST X registers. The trigonometric mode doesn't matter, but very large numbers tend to degrade the accuracy of the result.

01 LBL "HAG" 04 LBL a
02 R-P 05 X<> L
03 P-P 06 R T N

Here's a set of routines that was sent to us by Gary G. Price of Madison, Wisconsin. Those who don't have the Math Pac, but would like to have the hyperbolic functions programmed into their HP-41 will find this set of routines useful.

(41) The following are suggestions for your "routines" column in HP KEY NOTES. They are routines to compute the hyperbolic functions with an HP-41. Their features include:

1. Each makes no calls to others, so persons who routinely need one or two need not tie-up program memory with superfluous ones.
2. Each requires only the stack and leaves at least the Y-register intact. The Math Pac uses register 00.
3. Each has been honed to minimize the number of bytes required.
4. Labels that are more verbose than necessary are used here to show correspondence to the routines available in the Math Pac.

01 LBL "TANH" 08 LBL J 12 +
02 ENTER 13 2
03 SF 00 14 /
04 LBL H 15 FC 20 00
05 SF 01 16 R T N
06 LBL I 17 X<>Y
07 ET X 18 XEQ I
08 ENTER 19 /
09 1/X 20+LBL "HYP"
10 FS 20 21 SF 27
11 CHS 22 R T N

The Time Module for the HP-41 makes all those timer routines that we have published in past issues of KEY NOTES obsolete (Whew!!). This is not to say that they won't have nostalgic value; sure, the children will love to see how we used to turn our calculators into timers.

This next routine is not a timer routine. It was sent to us by Basil Allsop, from Kikuyu, Kenya. You might be able to use this idea to spice-up some of your programs.

(Steps 06, 09, 12, and 13 really don't do anything but slow the execution of the program. If SF 09 is used at step 05 instead of GTO "?", the slow global label search is avoided—Ed.)

01 LBL "T" 09 R-P
02 SF 25 10+LBL 01
03 " 0 0 0 0 0 0" 11 TONE 4
04 R V E W 12 R-P
05 GTO "?" 13 R-P
06+LBL 00 14 GTO 00
07 TONE 5 15 R T N
08 P-R

And, for you HP-65 owners who say we never give you anything, we have this routine. It was contributed by Bob Flyn of Longview, Washington.

(65) This routine converts slope distance and percent slope to horizontal distance. Place the slope distance in the Y-register and the percent slope in the X-register.

01 LBL "MAG" 04 X<> Y
02 R-P 05 X<> L
03 P-P 06 R T N

And, in response to this set of hyperbolic functions, the technical staff of KEY NOTES combined the SINH, COSH, and TANH routines into the program below called HYP.

(41) With this program keyed into your HP-41, simply XEQ ALPHA HYP ALPHA to turn the SIN, COS, and TAN keys into SINH, COSH, and TANH keys. (The function of the keys changes but the white plastic letters on the keys stay the same.) If you don't wish to have TANH available, then save some program space by deleting lines 01-03, and 15-19. If you would like to call these functions as subroutines from other programs, then add the following global labels: LBL "TANH" above LBL J; LBL "SINH" above LBL H; and LBL "COSH" above LBL I.
Where is the First HP-35?

Why is the gentleman in this photograph smiling? You would smile, too, if you had, in your hands, the very first HP-35 calculator sold in January 1972! Would we fool you about that? Read on...

Late last year, as we were approaching the tenth anniversary of Hewlett-Packard calculators, we thought of various ways to celebrate the event. So we looked through the records and found the very first sale for an HP-35. Lo and behold! The owner is Dr. Russell J. Donnelly, a Professor of Physics at the University of Oregon in Eugene, Oregon, which is but a short 40 miles south of Corvallis.

So we invited Dr. Donnelly up to Corvallis and shot this photograph of him and his trusty HP-35. It is somewhat "worn" in some areas, but it works just as well as the day it was purchased. And, no it is NOT for sale—for any price. In fact, it now resides in a bank, safe and sound for posterity.

Not only is it a coincidence that the "first" HP-35 is so close to "home," but also that the owner's son works for Corvallis Division!

New Accessories Released

The following accessories are now available for the HP-41 Calculator/Computer System and the HP Interface Loop (HP-IL).

- HP 82167A 0.5 Meter HP-IL Cable
- HP 82167B 1.0 Meter HP-IL Cable
- HP 82167D 5.0 Meter HP-IL Cable

These accessories should now be at your local HP Dealer. Remember: if you order from the factory, you will have to pay an additional $3.50 handling charge.

Even More About Batteries

FACTS ABOUT PACKS

The HP 82120A Rechargeable Battery Pack that became available in June of 1980 is an economical power source for those who use a card reader with an HP-41 or for any heavy user of the HP-41, with or without peripherals. The pack is more compatible with the HP-41 and card reader than are the N-cell alkaline batteries because the nickel-cadmium batteries in the pack maintain a higher voltage throughout the discharge cycle, and the card reader demands a relatively high available voltage. The N-cell alkaline batteries are an excellent power source when the card reader is not used because they offer many, many hours of steady, lower-voltage power. When the HP-41 is used alone, or with peripherals other than the card reader, it makes very efficient use of the low-voltage power supplied by the N-cell alkalines. For the average user without a card reader, the N-cell alkalines may prove to be the most economical power source.

COMMON QUESTIONS

Here are answers to five of the most common questions about batteries in the HP-41:

1. How long will my rechargeable battery pack last?

Under normal conditions, a battery pack will last from 500 to 1000 charge cycles. One full charge cycle constitutes fully charging the battery pack and using the calculator until the battery indicator comes on. Once fully charged, a battery pack will provide the user with approximately 10 hours of continuous operation on an HP-41 with no attached peripherals before requiring a recharge. With the continuous use of peripherals, the hours that the battery pack provides will decrease. Six charge cycles will approximately equal the life of one set of N-cell alkalines if you use the HP-41 continuously in a running program with no attached peripherals. Two charge cycles will approximately equal the life of one set of N-cell alkalines if you use the HP-41 continuously with the card reader. And, if you use the HP-41 continuously with the wand, then five charge cycles will approximately equal the life of one set of N-cell alkalines. These numbers are only approximations, but they are valuable for determining which power source is the most economical for you.

2. How can I get the maximum life from my rechargeable battery pack?

Fully charge the battery pack. Disconnect the calculator from the charger until the BAT indicator comes on in the display, then repeat the cycle. The battery in your car will last the longest if it is never thoroughly discharged, but this isn't the case with nickel-cadmium batteries. Once you start the discharge cycle it is best to continue to use the calculator until BAT comes on before recharging. Don't let nickel-cadmium batteries go completely dead, though. This may cause the polarity of one or more of the cells to reverse, which makes the pack impossible to recharge.

3. What if I want to leave the calculator and charger continually plugged in my desk, for instance?

Leaving the calculator and charger plugged in is common, and it will not harm the batteries or charger. This maintains a full charge in the batteries. But, remember, when you unplug the calculator overnight it starts into the discharge cycle and it's best to use it until BAT comes on.

4. Why don't I get the full expected operating time from my battery pack?

The operating time from your battery pack depends on several factors—ambient temperature, age (the number of charging cycles), the type of operations being performed (programming vs. simple addition vs. printing), etc. Also, nickel-cadmium batteries can develop a condition called "memory" that is a temporary loss of charging capacity. To illustrate, suppose your calculator is kept on the recharger continually, except for a 20-minute period each day when it is used on battery power alone. Over a long period of time (months), the batteries will begin to "remember" the capacity that they are expected to deliver each day—20 minutes—and they will deliver no more than that amount. If you alternate using the recharger and battery power for random periods, then no harm is done. It is only the repeated discharge cycles of the same duration that produce the "memory" effect. Full charging capability can be restored to a good battery with several full charge cycles as described in question 2.

5. What do I do if the card reader stops in the middle of reading a card because of a low battery? I can't turn off the calculator, and I am not supposed to remove the card reader while the calculator is on.

Remove the card from the card reader with a firm steady pull on either end of the card. It may take a little force but it won't harm the card or the card reader. You should now be able to turn off the calculator. Turn the calculator back on. If the BAT annunciator doesn't come on, then you can continue to use the calculator alone for some time. Don't try to read a card again until the charger is plugged-in or fresh batteries have been installed.
KEY NOTES
Subscription Plan

You were informed in the last two issues that, because of skyrocketing inflation, we would soon be charging a subscription fee for HP KEY NOTES. This notice and a Subscription Order is being repeated in this last free issue for those who might have missed it or who are reading KEY NOTES for the first time. In February 1982, Volume 6 Number 1 will be mailed ONLY TO THOSE WHO SUBSCRIBE BEFORE THAT TIME. Below are more details.

FOR U.S. AND CANADA

In the United States and Canada the subscription fee will be $5* for one year. For that fee you will receive four issues of KEY NOTES a year.

We will accept subscriptions any time after November 1, 1981. Just fill in the Subscription Order, then mail it (or a photocopy) and a check or money order for $5* to the Users' Library in Corvallis (address on back cover).

All copies of HP KEY NOTES distributed in the U.S. and Canada will be sent by first-class mail. (By U.S., we mean any address with a U.S. Post Office ZIP code.)

If you are a member of the Corvallis Users' Library and live in the U.S. or Canada, you will receive HP KEY NOTES free for 1982.

On January 1, 1982, all current members of the Corvallis Users' Library will be added to the HP KEY NOTES subscription mailing list for one year—free of charge. Such people do not have to send in the Subscription Order. We will automatically put you on subscription for 1982. Also, everyone who joins the Users' Library in 1982 will receive a free one-year subscription to HP KEY NOTES.

FOR EUROPE (UPLE)

If you live in Europe and receive HP KEY NOTES through the Users' Program Library Europe (OPLE) in Geneva, Switzerland, you will presently continue to receive HP KEY NOTES, and you will receive it free in 1982. The issues you receive will be printed in the U.S. and bulk-shipped by air freight to the Amsterdam mailing house.

INDIVIDUAL COPIES CANNOT BE OBTAINED FROM CORVALLIS unless you are a paid-up member of the Corvallis Users' Library. If and when this plan changes, you will be notified in advance.

You do not have to send in the Subscription Order.

FOR ALL OTHER COUNTRIES

If you live in Mexico, South America, Africa, Australia, New Zealand, or Asia, or in any country not covered above, please fill in the Subscription Order on this page and mail it to the nearest Hewlett-Packard office. This will assure that you will continue to receive HP KEY NOTES in 1982. If you cannot determine where to send the form, send it to Corvallis, and we will see that it gets to the right location. Depending on where you live, you might be asked to pay a mailing fee in order to continue receiving HP KEY NOTES.

Before You Fill-In Your Order...

Do not mark the first option if you choose the third option. KEY NOTES is included (for 1982) in a Corvallis Library subscription. In other words, do not send $25 or $35 with your order.

Do not send cash if you can avoid it. Use a check or money order, payable to Hewlett-Packard in U.S. dollars, and drawn on a U.S. bank. Or use your American Express, MasterCard, or VISA charge account and furnish your name exactly as on the card, plus the card number and expiration date.

Do not send purchase orders or request invoices for the $5 KEY NOTES subscription. If you want your company to reimburse you, use the Subscription Order as an invoice or use it to apply for Petty Cash funds.

Do mail your order to: KEY NOTES Subscription; Hewlett-Packard Company; Corvallis, Oregon 97330.

Our thanks to all of you who have already sent your checks and orders. As of November 2 (the start of our fiscal year) we have begun entering KEY NOTES subscriptions for 1982.

当然，如果你住在美国以外的任何地方，你都是会员的Corvallis Users' Library，你不需要发送给HP KEY NOTES。你将在1982年作为部分你的图书馆订阅。

FOR THE FUTURE

Effective January 1, 1982, we will include a copy of the current KEY NOTES and an invitation to subscribe to it inside each HP-41, HP-67, and HP-97 carton.

AND FINALLY...

We want you to know that, as a result of this subscription plan and future plans, KEY NOTES will only get better. You will get it on a regular schedule. There are still a few “bugs” to iron out of some overseas shipments, but we are making progress. Right now, Europe receives KEY NOTES five times faster than just a year ago. And perhaps we can improve on that record.

Without the economic problems that have haunted the newsletter of late, and by using better classes of mail and freight delivery, you will find that KEY NOTES will be a regular companion—there when you count on it. And with many exciting improvements in the next year, you won’t want to miss getting KEY NOTES.

* U.S. dollars. Orders from anywhere outside the U.S. must include a negotiable check (or money order), in U.S. dollars, drawn on a U.S. bank. Payment must accompany your order.
Stock Plotting on the HP-41

Oak Park, Illinois, is the home of James Grandstaff. He has developed this routine for use on the HP-41 with the HP-82143A Thermal Printer/Plotter, and it will work with the new HP-IL compatible printer, the HP 82162A Thermal Printer/Plotter.

(41 with printer) While reading HP KEY NOTES, V5N2p12, I came across the item by W. W. Trotti, Jr. I wrote a similar subroutine for plotting a weekly stock chart. The subroutine prints the weekly dates, month by month, on the X-axis and the stock values on the Y-axis. It stops to prompt the user for each Y-value. The calendar function takes care of leap years and year-end roll-overs in the graph.

To use this routine:

1. In the X-register, place the date that corresponds to the first stock value you want to plot. The form of the date is MMDD.YYYY (NOT the standard form).
   For example, 102.1981 starts the stock graph at January 2, 1981.

2. XEQ ALPHA DATE ALPHA
3. XEQ ALPHA PRLPLOT ALPHA

The calculator will proceed to ask seven questions and then start prompting for data. Respond to the questions in the following manner:

**QUESTION**

**NAME? STOCK**

**Y MIN?** minimum stock price

**Y MAX?** maximum stock price

**AXIS?** purchase price (between YMIN and YMAX)

**X MIN?** day of the month for first entry (between 1-31)

**X MAX?** 100

**X INC?** 7 (days per week)

| @1*LBL *STOCK* | 47 STO 13 |
| @2 STO 12 | 48 RTN |
| @3 ? | 49*LBL 02 |
| @4 ST+ 06 | 50 X=Y? |
| @5 XEQ 06 | 51 SF IND 15 |
| @6 7 | 52 RBN |
| @7 ST- 06 | 53 RTN |
| @8 RCL 12 | 54*LBL 03 |
| @9 STOP | 55 1 E2 |
| @10 RTN | 56 RCL 06 |
| @11*LBL 00 | 57 + |
| @12 RCL 06 | 58 RCL 17 |
| @13 RCL 06 | 59 FRC |
| @14 X=Y? | 60 + |
| @15 RTN | 61 1 E-4 |
| @16 - | 62 + |
| @17 CHS | 63*LBL "DATE-

Here is a plot of HP stock from August 17, 1981 to December 14, 1981.

**PLOT OF STOCK**

**X (UNITS= 1) +**

**Y (UNITS= 1) +**

**39.0**

**49.0**

---

**46.8**

**47.0**

---

**46.8**

---

**HP KEY NOTES**

January-February 1982 Vol. 6 No. 1

Programming and operating tips, answers to questions, and information about new programs and developments. Published periodically for owners of Hewlett-Packard fully programmable personal calculators. Reader comments or contributions are welcomed. Please send them to one of the following addresses:

Hewlett-Packard Company
Users' Library
1000 N.E. Circle Boulevard
Corvallis, Oregon 97330 USA

Hewlett-Packard SA
Users Program Library Europe
7, Rue du Bois-du-Lan
P.O. Box, CH 1217 Meyrin 2
Geneva Switzerland

Hewlett-Packard Company
Corvallis Division
1000 N.E. Circle Boulevard
Corvallis, Oregon 97330 U.S.A.
Address Correction Requested
Return Postage Guaranteed

FIRST-CLASS MAIL
U.S. POSTAGE
PAID
PERMIT NO. 814
PORTLAND, OR

Page 16

Printed in U.S.A.